NTSB Unmanned Aircraft Systems Safety Forum

Summary of Information Exchanged

On April 29 and 30, 2008, the National Transportation Safety Board (NTSB) conducted a public forum, chaired by Board Member Kathryn O'Leary Higgins. Board Members Deborah Hersman and Steven Chealander, Office of Aviation Safety Director Thomas Haueter, and Office of Research and Engineering Director Vernon Ellingstad also participated on the Board of Inquiry. Additionally, six NTSB staff members participated as part of the forum's Technical Panel: Pamela Sullivan, Dana Schulze, Daniel Bartlett, Steven Magladry, Dr. Evan Byrne, and Jeffrey Marcus. The forum brought together participants in the unmanned aircraft systems (UAS) industry to discuss the needs, challenges, and experiences associated with the safe integration of unmanned aircraft (UA) into the U.S. National Airspace System (NAS).[1] The Federal Aviation Administration (FAA) and subject matter experts from the aviation community presented and discussed information related to the safe integration of UASs into the NAS and the policies, practices, and procedures in use today and those planned for the future. The public also participated during question-and-answer sessions throughout the forum. This document is a high-level review of the main points of the information exchange that occurred during the 2-day forum.

For additional and more detailed information, readers are encouraged to review the materials generated from this forum, which are archived on the NTSB's website. For example, the forum brochure containing a synopsis of the panel topics and biographies of Technical Panel members and forum presenters (**UAS Forum Overview**), the detailed agenda and presentations for each panel (**Agenda and Presentations**), and an archive of the video webcast (**Video Webcast**) are available.

Forum Objectives

The NTSB's objectives for the forum were to 1) educate the public and the Safety Board on the safety of present and future UAS operations in civil airspace; 2) enable several involved parties to share lessons learned; and 3) expand the knowledge base on matters related to the investigation of UAS accidents and incidents.

The 2-day forum was organized into seven panels, which will be discussed in the next section. Panels comprised experts from industry, academia, and the Government. These experts talked about their experiences with UASs and the hazards that UAS operations can present. They also shared their knowledge and lessons learned, which have helped shape the policies, practices, and procedures used today to manage the associated safety risks.

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[1] In 2006, the NTSB conducted its first investigation of a UA accident; for additional information about the accident, see **CHI06MA121**. As a result of its investigation, the NTSB issued 22 safety recommendations addressing UAS design, operation, and safety management (see **FAA recommendations** and **U.S. Customs and Border Protection recommendations**). However, this investigation raised questions concerning the broader issue of how UA will fit into the existing aviation system and the safety challenges such integration will present. The Board realized that it needed to know more about the current and future operation of these aircraft in the U.S. NAS and believed that a national dialogue about the safest way to operate these aircraft would benefit the UAS industry and the public.

Key Points of Information Exchanged

The information shared by the panelists and the dialogue between those panelists, the NTSB, and the public served to achieve the NTSB's objectives for the forum. This section summarizes points discussed in each panel during the forum. The points reflect issues and needs identified by the participants and are not to be considered NTSB recommendations.

Panel 1: Regulatory Issues

- The FAA is the authority that grants access into, and operations within, the NAS for all aircraft, including UA.

- Until detect, sense, and avoid capability is certified and available, and appropriate rulemaking has been established, a UAS operator can gain access into the NAS only via a certificate of authorization (COA) or an experimental airworthiness certificate in the experimental category (EC).

- Public-use operations account for most of today's non-military UAS activities in the NAS. Public-use organizations are responsible for defining their own equipment and operational safety requirements. To operate UASs in the NAS, the FAA requires public-use organizations to comply with certain existing FAA regulations and to obtain a COA.

- COA approval for industry (civil for profit) is not expected in the near term.

- Initial rulemaking efforts to integrate UASs into the NAS are focused on small UASs.

- The FAA does not have specific airworthiness standards for UAS design, construction, or maintenance. Currently, operators are self-certifying their UASs to be safe and airworthy.

- Because UASs vary in size, weight, and capability, the definition of what should be a regulated UAS is not clear.

Panel 2: Integration of Unmanned Aircraft Systems into the National Airspace System

- Air traffic controllers do not fully understand and are not fully aware of all potential UAS applications, their impact on the NAS, their integration into the NAS, and mitigation considerations.

- Standardized procedures for normal situations—and abnormal ones such as for lost-link operations—will help all involved in the NAS (air traffic controllers, UAS pilots, manned-aircraft pilots, etc.) anticipate UAS performance.

- The FAA is developing procedures and training for its air traffic controllers on how to work with and manage UASs.

Panel 3: Current Certificate of Authorization Operations and Lessons Learned

- The endurance and remote capabilities of UAS technology can benefit national priorities, including homeland protection, atmospheric measurement (climate change, weather

forecasting), assistance with firefighting, pipeline and nuclear facility monitoring, and assistance with local law enforcement's public safety role.

- UAS operations can be integrated more effectively when stakeholders who manage the operation, such as air traffic controllers and airspace users, communicate early and often during the planning stage.

- Hazard analyses by UAS operators are critical to identifying and managing safety risks. The results of these analyses will affect system design, the mission plan and rules, and contingency plans and form the basis for determining flight readiness.

- An operational risk assessment can be used to help determine how to safely conduct UAS operations in the NAS and is especially beneficial when conducting operations with UASs designed for military purposes.

- The Interagency Committee for Aviation Policy (ICAP), whose members include Federal agencies who use aircraft, has a role in regulating and assisting Federal agencies on matters related to UAS operations. ICAP is updating 41 *Code of Federal Regulations* 102-33 to maintain an inventory of all Federally owned UASs.

Panel 4: Perspectives of Other National Airspace System Users

- Integrating UASs within the existing safety framework for the NAS without imposing new airspace restrictions on other users is ideal.

- The goal for UAS equipment and operations is to live up to the high standards for certification, pilot qualification, and training set for manned applications.

- Panelists stated that, given the lack of UAS equipment certification standards and the inability for UA to see and avoid other traffic, before allowing them unrestricted access to the NAS, planned UAS operations should undergo a detailed safety risk assessment to consider the potential hazards that they may introduce to people in the NAS and on the ground. The safety risk assessment would include cases where the UA is flying above and below altitudes normally used by airline operations.

- The aviation industry is not fully aware of all potential UA applications, the impact they will have on the NAS, and mitigation considerations.

Panel 5: Unmanned Aircraft System Equipment Design Standards, Airworthiness, and Maintenance

- The development of design standards and requirements for UAS detect, sense, and avoid capability; command and control data links; and the UASs themselves is essential and necessary for manufacturers to be able to design and build UASs that the FAA can approve for unrestricted flight in the NAS.

- Military UAS operators recommended that UAS designs be evaluated using the same processes used to ensure manned aircraft's airworthiness and that UASs not be operated without an airworthiness release that ensures subsequent changes to the

design are properly evaluated, tracked, and approved as part of the airworthiness release process.

- UASs not originally designed using existing airworthiness standards for manned civil aircraft may be difficult to modify for redeployment into civil airspace and may need additional, operationally based risk mitigation.

- Department of Defense experience suggests that large UASs designed using applicable existing airworthiness standards would help mitigate risk, whereas small UASs can be safely managed through a rigorous operational risk assessment process.

Panel 6: Human Factors

- Ensuring that a pilot's knowledge of the NAS is consistent with the intended operation's scope is necessary for UAS pilot certification.

- Early human systems integration in the UAS design process could reduce the opportunities for design-induced human error and ideally would draw from existing knowledge, design standards, and human factors lessons learned from manned aviation.

- Displays and systems used in UASs that compensate for UAS pilots' lack of sensory input while performing their tasks would help pilots detect anomalous events affecting safety of flight in a timely manner.

- UAS operations typically involve teams; efforts to ensure clear communication and effective coordination can decrease the opportunity for human error.

- Fatigue management systems are important in UAS operations.

Panel 7 (Case Study): National Aeronautics and Space Administration's (NASA) Ikhana Unmanned Aircraft System Fire Mission

- Extraordinary lead time and coordination with NAS stakeholders and others were required for the success of this mission.

- Preparations for the fire mission were labor-intensive because of the proposed operation's geographic scope and the corresponding FAA requirements to mitigate the safety risks.

- Although NASA's Ikhana UAS successfully accomplished the planned mission, the mission required substantial resources and time to gain access to the NAS.

General Summary

As Member Higgins noted in the forum's opening statement, the safe operation of UASs in the NAS must be assured if UASs' full potential is to be realized and supported by the public and Congress. The challenge is for UAS operations to maintain an equivalent level of safety to manned aircraft operations and to do so given the wide range of UAS designs, sizes, and applications. Understanding how much risk that a particular UAS mission poses to the public was the subject of repeated discussion and, at times, debate during the 2-day forum.

Understanding this risk is a key first step to determining what specific requirements must be put in place to keep the risk to an acceptable level.

The FAA is authorizing UAS operations and determining risk on a case-by-case basis as part of the COA application process for public-use operations or as part of an EC for civil-use applications. However, it was made clear during the 2-day forum that the increasing number of applications in these areas is stretching the FAA's available resources. This limited throughput can also affect industry research and development efforts to bring new UASs on line. The FAA's focus on creating an Aviation Rulemaking Committee for small UAS design and operational requirements is one effort that should help in this area, along with the FAA tasking the RTCA, Inc.'s UAS Committee (SC-203) to develop performance standards for UASs.

Member Higgins stressed in her closing statement at the forum that these efforts should not be protracted because of UASs' criticality to so many facets of our Nation's interests. She challenged the attendees from the FAA, the U.S. military, UAS manufacturers, and all airspace users to work together so that the necessary manpower and logistical resources are made available to finish the tasks required to safely integrate UAS into the NAS in a reasonable timeframe without compromising safety.

The NTSB's interest in the safe integration of UAS into the NAS remains high. Our Office of Aviation Safety will continue to monitor Government and industry developments in this area, and the NTSB will continue advocacy efforts to help ensure that the recommendations issued in October 2007 to improve UAS safety are adopted.